DRAFT

Water Management Strategy Evaluation Framework

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CALFED
BAY-DELTA
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Acronyms

ERP	Ecosystem Restoration Program
ERPP	Ecological Restoration Program Plan
ISI	Integrated Storage Investigation
WMS	Water Management Strategy
WMSEF	Water Management Strategic Evaluation Framework
WQP	Water Quality Plan
WQPP	Water Quality Program Plan

Preface

In the *Revised Phase II Report* (June 1999), CALFED identified three broad goals for a Water Management Strategy (WMS) to guide the implementation of water management tools throughout Phase III of the Program. Those goals are to:

- Develop a menu of water management tools that can be used to attain CALFED's water supply reliability goals;
- Identify specific water management tools from this menu that will be implemented in Stage 1 of the CALFED Bay-Delta Program; and
- Provide a long-term decision-making framework for evaluating the success of implementation efforts and for selecting additional tools needed to achieve CALFED's objectives.[1]

The following report addresses the third WMS goal. It presents an initial approach to evaluating the effectiveness of alternative combinations of water management tools in accomplishing CALFED's objectives over the long term.

A brief review of the relationship of this effort to other WMS goals and activities may offer useful background and context. As a starting point, the menu of water management tools referred to in the first WMS goal fall under the following broad headings:

- Water Use Efficiency Program tools (agricultural, urban, and wetland water conservation and water recycling);
- Water Transfers Program tools;
- Water Quality Program tools;
- Conveyance, including South Delta Improvements;
- Storage; and
- Operational strategies.

To address the second goal, CALFED has recently established a Water Management Development Team, consisting of agency and stakeholder representatives, to advise policy makers on the appropriate tools to be implemented during Stage 1 of the Program. A Preliminary Stage 1 Implementation Framework is currently under development.

[1] *Revised Phase II Report* (June 1999) p. 53.

In support of the third goal, CALFED has undertaken several other efforts that contribute to the long-term framework for evaluating and implementing additional water management tools. Refinements to CALFED's Water Use Efficiency, Water Transfer, and Water Quality Programs are among these efforts. To provide additional information regarding the role of storage, CALFED has initiated an Integrated Storage Investigation (ISI).

The ISI coordinates storage studies being conducted by individual CALFED agencies, CALFED-initiated storage evaluations, and broader water management strategies and analyses. The ISI will provide a comprehensive assessment of alternative storage options and their utility to overall water management.

In addition to helping finalize the WMS component of CALFED's programmatic plan in time for the completion of the Final PEIS/EIR Record of Decision, the ISI serves the longer-term purpose of determining the feasibility of specific storage and conjunctive use projects. These efforts are expected to continue into Stage 1 of implementation of the CALFED Program. Studies currently underway include investigations of:

- Conjunctive Use;
- North of Delta Off-Stream Storage;
- In-Delta and Off-Aqueduct Storage; and
- On-Stream Storage Enlargement.

Studies that have already been completed and are available as input to the WMS Evaluation Framework include:

- Reservoir Screening;
- Conjunctive Use Site Appraisals;
- Hydroelectric Facility Reoperation;
- Riverine Processes Investigation;
- Drinking Water Quality Operations;
- Operational Flexibility; and an
- Economic Evaluation of Water Management Alternatives.

This information, along with the Water Use Efficiency, Water Transfers, and Water Quality Programs, will be considered in the proposed WMS Evaluation Framework described in this document. This proposed framework will allow for comprehensive comparisons of alternative WMS approaches that emphasize different water

management tools. CALFED policy makers will weigh the tradeoffs associated with these different approaches in crafting a final programmatic WMS.

Section 1
Introduction

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Section 1
Introduction

"The achievement of objectives is the sole reason for being interested in any decision. And yet, unfortunately, objectives are not adequately articulated for many important decisions."[2]

Establishing CALFED's long-term Water Management Strategy (WMS) represents an important decision-making process in the Bay-Delta Program. The Water Management Strategy will define for many stakeholders in the CALFED process both the essential benefits and consequences resulting from program implementation. Its emphasis on increasing the utility and access to supplies for all beneficial uses and improving management flexibility to reduce conflicts among uses makes the Water Management Strategy a pivotal output of the CALFED process.

The best place to start the search for appropriate performance measures and creative alternatives is often a return to basics.

This report presents a framework for evaluating alternative water management strategies. The framework is designed to support the decision-making process and help arrive at a broadly supportable WMS. It focuses on: (1) establishing a comprehensive list of performance measures (or evaluation criteria) that can be used to compare the relative value of alternatives, and (2) encouraging a creative approach to the development of successful alternative strategies.

Like other complex decisions with multiple purposes and many diverse stakeholders, the best place to start the search for appropriate performance measures and creative alternatives is often a return to basics. What are the objectives that the program is attempting to accomplish? Are they fully developed and clearly articulated? Can clear performance measures be identified which will indicate success in accomplishing objectives? Have creative options been advanced that provide a clear means to achievement of every fundamental purpose of the program? These are among the questions that are addressed in the following report. The answers provide a direction and framework for further analysis and should offer the foundation for decision making at this milestone in the CALFED program.

1.1 Mission Statement

Simply stated, the mission of the evaluation framework refinement effort is to: (1) document a comprehensive hierarchy of objectives for the CALFED Program, (2) establish well-defined measures of performance associated with the achievement of objectives, and (3) provide a basis for comprehensive comparison of alternative long-term water management strategies.

[2] Keeney, Ralph L. *Value Focused Thinking* (1992).

In order to provide guidance and input to the effort, a stakeholder group was identified and invited to participate. The stakeholder process accompanying this effort involved a series of three workshops over a period of approximately one month, as well as individual interviews with workshop participants. The interviews focused on uncovering stakeholder views on overall program objectives and identifying possible performance measures for assessing success in achieving objectives. The workshop process provided an opportunity to introduce concepts and methodology, and receive feedback on the presentation of fundamental objectives, means-ends objectives, and performance measures presented in this report.

1.2 Conceptual Approach

The overall conceptual framework for the evaluation of alternative water management strategies involves the following series of steps:

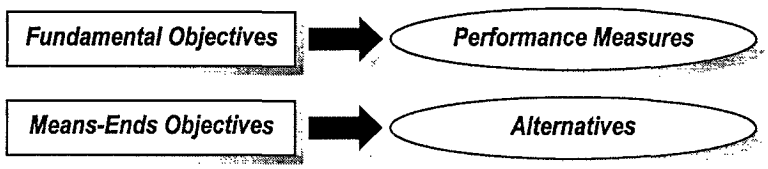
1) Define the hierarchy of fundamental objectives.
2) Identify a network of means-ends objectives.
3) Establish the indices used to measure performance.
4) Clarify planning assumptions.
5) Evaluate water management strategy alternatives against performance measures.

These steps are essentially iterative activities. That is, at every point in the process, it is appropriate to revisit the prior steps and apply knowledge learned to the refinement of earlier conclusions. The clarification of stakeholder values and preferences may shed light on fundamental objectives, and it is likely that the evaluation of alternatives will suggest or prompt the creation of additional means-ends objectives.

This interim report presents findings related to the initial steps (1-3) in the assessment process and sets the stage for subsequent evaluations. It offers the essential elements of a framework and approach. It does not include the actual evaluation of alternative water management strategies.

1.3 Defining Objectives and Performance Measures

The first steps in the evaluation framework involve the definition of objectives and the establishment of performance measures. Importantly, objectives are broken down into two distinct categories: (1) fundamental objectives, and (2) means-ends objectives. *"Fundamental objectives"* are defined as the essential reasons or purposes for undertaking the CALFED Program. They answer the basic question "why are we undertaking the program in the first place?" Once fundamental program objectives have been established, the evaluation framework is designed to predict how well alternative water management strategies will perform in accomplishing these essential purposes of the program.



In addition to the establishment of a preliminary hierarchy of fundamental objectives, networks of means-ends objectives were developed as well. *"Means-ends objectives"* are those objectives that focus on how fundamental objectives can be accomplished. They answer the basic question "how can we achieve our purposes?" Much of the effort expended in the CALFED Program has focused on the identification and analysis of specific means for the achievement of fundamental objectives.

It is not uncommon for decision processes to break down as a result of a heavy emphasis on means-ends objectives.

The evaluation framework makes an important distinction between those objectives that reflect the fundamental purposes of the program and those that address the means by which fundamental objectives are accomplished. It is not uncommon for decision processes to break down as a result of a heavy emphasis on means-ends objectives. The discussion of surface storage and groundwater storage as elements of a water management strategy is a good example of a debate over the "means" of accomplishing fundamental program objectives in a narrow context. It is necessary to revisit the underlying purposes of the program to achieve agreement or closure on the fundamental goals of the decision before the merits of alternative storage proposals can be evaluated.

Finally, *"performance measures"* are the indicators or indices of how an alternative or option performs in achieving fundamental objectives. Where possible, they should be quantifiable criteria for assessing how an alternative performs. Performance measures should naturally "map" back to the fundamental objectives of the program.

1.4 Interim Findings

Based on the exercise of sorting the extensive array of CALFED objectives into the distinct categories of (1) fundamental objectives, and (2) means-ends objectives, some initial conclusions can be drawn. Overall, for the four primary program elements (ecosystem restoration, water quality, water supply reliability, and levee protection), fairly extensive networks of fundamental and means-ends objectives have been developed.

1.4.1 Conflicting Stakeholder Interpretations of Fundamental Objectives

In some cases, stakeholder interpretations of fundamental objectives conflict. This is particularly evident in the area of water supply reliability, where stakeholder views vary regarding the CALFED Program's role in meeting the water needs of the beneficial users of water delivered through the Delta. One view would have the

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fundamental objectives of the Program include an explicit commitment to developing additional water supply for beneficial users. Another view challenges the concept of "additional" water and would have fundamental program objectives focus on reducing the dependency of beneficial users on existing supplies and reallocating remaining supplies among users. This conflict leads naturally to a wide divergence of opinion regarding the means of achieving water supply reliability goals.

While these differences of opinion may not be resolvable in the near-term, there is general agreement on the appropriate measures for predicting the performance of alternative strategies relative to water supply reliability.

1.4.2 Integrating the Evaluation with Other Program Elements

Another observation evident from the exercise is that the method of integrating competing objectives is not well developed. As expected, in those cases where fundamental objectives are not in explicit conflict, the means-ends objectives frequently compete. In attempting to achieve one fundamental objective it is not unusual to find potential competition with another objective. For example, in terms of water quality and quantity, many of the objectives of environmental, agricultural and urban water users are achieved using the same resources.

The relationships that exist among competing objectives require the integration of decision making across all program elements. Consequently, the effort to develop fundamental and means-ends objectives was not limited to the water supply reliability element of the program. Ultimately, the WMS must be evaluated in terms of its contribution to the achievement of all CALFED Program objectives.

1.4.3 Recognizing Fundamental Objectives Inherent in the Solution Principles

One of the most potentially significant outcomes of the effort to establish an evaluation framework was recognition that the Solution Principles developed for the CALFED Program actually represent fundamental objectives for many stakeholders. The six Solution Principles - reducing conflict, being equitable, affordable, durable, implementable and avoiding significant redirected impacts - are, for many, fundamental purposes of the CALFED Program. A WMS that does not perform satisfactorily in the context of these principles is not likely to receive the endorsement or support of most participants and stakeholders in the CALFED process.

The Solution Principles developed for the CALFED Program actually represent fundamental objectives for many stakeholders.

Applying the six Solution Principles appears to be essential to the evaluation framework. At the first stakeholder workshop, which focused on fundamental objectives, every participant (regardless of the agency or the interest they represented) supported the concept that a fundamental objective of the CALFED Program should/must be to "protect the viability of California's economic sectors." It is easy to see this concept reflected in

the Solution Principles of equitability, affordability, durability, and no significant redirected impacts. And yet, these principles and their associated means-ends objectives and performance measures have not been subjected to the same level of development and refinement that the four program elements have received. Figure 1-1 illustrates the level of development for objectives and performance measures in the CALFED process.

What are the best means of achieving affordability, durability, or any of the other solution principles? This question has not been addressed with the same degree of thoroughness that has accompanied efforts to identify the means to achieve ecosystem restoration, water quality improvements, water use efficiency, and levee protection. It is reasonable to assume that a successful WMS needs to include program elements that address these important goals.

In the following report, a number of proposed performance measures are linked with the accomplishment of the Solution Principles. For example, measures of cost and economic impacts for alternative strategies are clearly indicators of success in achieving the fundamental objectives of equity, affordability, implementability and no significant redirected impacts. They are appropriately mapped to those principles and further highlight the potential gains that could be achieved by addressing the means of accomplishing Solution Principle objectives explicitly.

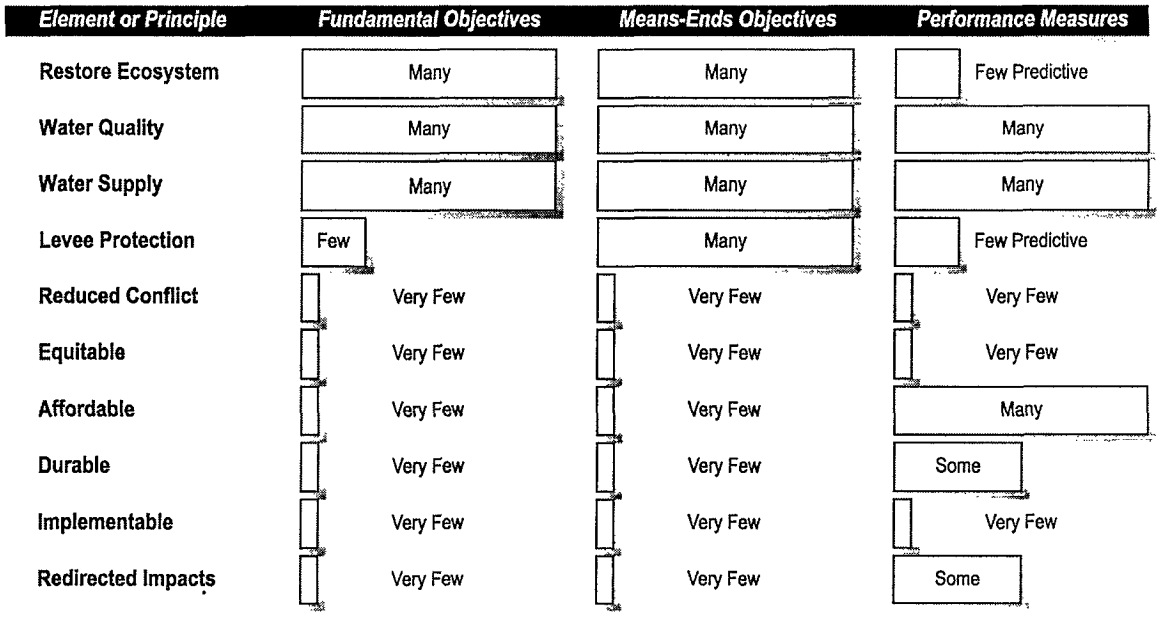

Figure 1-1

1.5 Preliminary Evaluation Framework

As described in the conceptual approach (Section 1.2), the evaluation of alternative water management strategies involves an iterative process of setting planning assumptions, creating alternative strategies, and predicting their comparative performance against established measures. That process is illustrated in Figure 1-2.

As a starting point, the preference sets established in the Economic Evaluation of Water Management Alternatives have been shown as examples of the kind of competing alternatives that will be evaluated. They each contain different combinations of tools for achieving overall water supply reliability benefits.

As planning assumptions are refined and the alternative strategies are scored according to their relative effectiveness in achieving program objectives, it is possible to recognize the trade-offs that are inherent in various combinations of water management tools. This analysis is then available to facilitate the process of uncovering the WMS that best fits the many competing objectives of the CALFED Program. As the effectiveness of water management tools is better understood through program implementation, this framework can also serve as the basis for on going Adaptive Management.

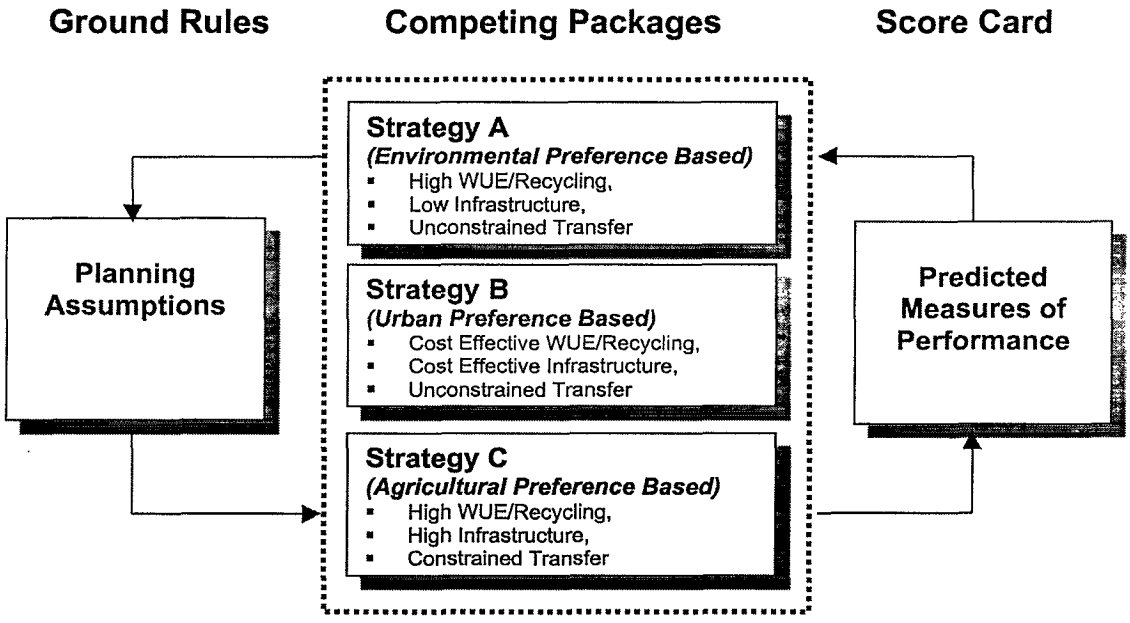

Figure 1-2

1.5.1 Planning Assumptions

The *ground rules* for the evaluation framework are the planning assumptions. The planning assumptions established for the evaluation set the context within which alternatives are expected to perform. They reflect the external conditions and/or constraints imposed on the analysis. Examples of the planning assumptions that will be used in the evaluation framework include:

- Hydrology;
- Water Use Demands;
- Delta Standards;
- Regulatory Requirements; and
- Other External Conditions or Constraints.

Adjusting the planning assumptions and repeating the analysis also allows for an assessment of the sensitivity of performance to changing circumstances. For example, extreme hydrologic and/or demand conditions may be dealt with more effectively by some alternatives and less effectively by others. This sensitivity to changing future conditions is itself a measure of an alternative's durability – one of the Solution Principles.

1.5.2 Alternative Strategies

Alternative strategies represent *competing packages* that will be available for consideration by stakeholders and decision-makers. The alternatives to be evaluated should include complete and feasible combinations of tools developed to achieve fundamental program objectives. The broad categories that will be covered in the definition of each alternative includes:

- Operating Criteria;
- South Delta Improvements;
- GW Storage;
- Surface Storage;
- Transfers;
- Water Use Efficiency and Recycling;
- EWA Rules;
- Finance Plan; and

- Other Potential Means.

The alternatives will comprise both the proposed water management tools and the financial plan associated with its implementation. In this way, the evaluation can reflect both the benefits and costs to stakeholders that result with each alternative strategy.

As mentioned earlier, this framework is intended to provide decision-makers with the ability to see tradeoffs among alternative approaches. Consequently, it is an iterative process designed to accommodate revisions to alternatives and subsequent re-analysis. In cases where a specific alternative may display a weakness in terms of its ability to satisfy fundamental objectives of the program and/or solution principles, an opportunity presents itself to work creatively towards the development of new "means" of achieving Program success.

1.5.3 Predictive Performance Measures

Finally, the set of performance measures is, in effect, a *score card* with which the alternative strategies can be compared. The predictive measures developed in Section 3 will be used to describe the comparative performance of each of the alternative strategies. These measures are directly related to fundamental program objectives and solution principles. In addition to predictive performance measures cited here, extensive on-going monitoring of actual performance throughout the CALFED Program elements offers the ability to implement adaptive management, while continuously improving the reliability of predictive models.

Section 2
Objectives of the CALFED Program

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Objectives of the CALFED Program

This section presents and discusses the objectives of the CALFED Program, including both fundamental objectives (essential reasons for undertaking the CALFED program) and means-ends objectives (ways in which the fundamental objectives can be accomplished).

Documentation of fundamental objectives provides a basis for the development of evaluative performance measures that can be used in the comparison of alternative water management strategies. Means-ends objectives provide the basis for developing the alternatives themselves. Section 2.1 below reviews the CALFED mission and describes the primary CALFED program elements. Sections 2.2 through 2.5 document the objectives of the program elements. Section 2.6 discusses the Solution Principles. Appendix A contains charts illustrating the objectives hierarchies described below.

2.1 CALFED Mission Statement and Primary Program Elements

"The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system."[1]

The CALFED mission statement embodies the fundamental objective of the CALFED program.

This mission statement embodies the fundamental purpose of the CALFED program, and is the starting point for the hierarchy of objectives that was documented as part of the WMSEF. CALFED has established the following objectives as necessary in fulfilling this mission:

- Provide good water quality for all beneficial uses;
- Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species;
- Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system; and
- Reduce the risk to land use and associated economic activities, water supply, infrastructure and the ecosystem from catastrophic breaching of Delta levees.[2]

[1] *Revised Phase II Report* (June 1999), p.6.
[2] *Revised Phase II Report* (June 1999), p.6.

Four program elements have been developed to achieve these fundamental objectives: Ecological Restoration; Water Quality; Water Management; and Levee Protection.

2.2 Ecosystem Restoration Program

The Ecosystem Restoration Program (ERP) is designed to achieve the program objectives pertaining to the ecological health of the Bay-Delta ecosystem. Section 2.2.1 below presents the fundamental objectives of the ERP and Section 2.2.2 provides an overview of the means-ends objectives available for meeting the ERP goals.

The fundamental objective of the ERP is to support sustainable populations of plant and animals.

The ERP objectives presented here are detailed in a set of documents comprising the Ecological Restoration Program Plan (ERPP). These documents include:

- *ERPP Strategic Plan for Ecosystem Restoration* (June 1999)
  - "The Strategic Plan provides the conceptual framework and process that will guide the refinement, evaluation, prioritization, implementation, monitoring and revision of ERP actions."[3]
- *ERPP Volume I – Ecological Attributes of the San Francisco Bay–Delta Watershed* (June 1999)
  - Volume I describes the Bay-Delta ecosystems in detail and describes the desired outcome of the ERP, providing the basis for ERP actions proposed to be undertaken.
- *ERPP Volume II – Ecological Management Zone Visions* (June 1999)
  - Volume II defines over 600 specific, prescriptive actions designed to achieve ERP goals.
- *ERPP Maps* (June 1999)

2.2.1 ERP Fundamental Objectives

The ERPP is the primary mechanism for recovery and conservation of species covered by the Multiple Species Conservation Strategy.[4] The fundamental objective of the ERP is to support sustainable populations of plants and animals. The approach for addressing this fundamental objective is to restore or mimic ecological processes and increase or improve aquatic and terrestrial habitats so that they will support diverse and valuable species. In the ERPP, the word "restore" is used to encompass restoration, rehabilitation, protection and conservation.

[3] *ERPP Strategic Plan for Ecosystem Restoration*, p. 1 .
[4] *Multiple Species Conservation Strategy* (June 1999)

CALFED's six goals for the ERP, as described in the ERPP Strategic Plan,[5] elucidate the desired future condition of Bay-Delta ecosystems and expand the definition of the fundamental objective. The six ERP goals are:

1) Achieve recovery of at-risk native species;

2) Rehabilitate natural processes;

3) Maintain and enhance populations of selected species for commercial harvest;

4) Protect or restore functional habitat types;

5) Prevent establishment of additional non-native species and reduce the negative biological and economic impacts of established non-native species.

6) Improve and maintain water and sediment quality.

As the charts in Appendix A show, those goals may be further defined by an expanded set of subobjectives. The expanded set of fundamental objectives describes the habitat types, species groups, ecosystem attributes and processes on which the ERP focuses.

2.2.2 ERP Means-Ends Objectives

As noted above, the ERPP describes over 600 programmatic actions designed to meet ERP objectives. Each programmatic action is essentially a means-ends objective for accomplishing fundamental objectives. The ERPP organizes these means-ends into four categories, containing actions that:

- Increase habitat;
- Minimize stressors;
- Protect species; and
- Improve processes.

The charts in Appendix A illustrate the subcategories of actions (means-ends objectives) described in the ERPP and provide references to the ERPP document, where the reader may find detailed descriptions.

[5] See *ERPP Strategic Plan for Ecosystem Restoration*, pp. 22-25

2.3 Water Quality Program

As discussed in Section 2.1, another one of the fundamental objectives of CALFED is to provide good quality water for all beneficial uses. The Water Quality Program (WQP) was developed as a corresponding program element. Section 2.3.1 presents the hierarchy of fundamental objectives for the WQP and Section 2.3.2 provides an overview of the means-ends objectives available for meeting those goals.

The WQP objectives presented here are detailed in a technical appendix to the *Draft Programmatic EIS/EIR* (June 1999) entitled *Water Quality Program Plan* (June 1999). The vision for the CALFED Water Quality Program is to create water quality conditions that fully support a healthy and diverse ecosystem and the multiplicity of human uses of the waters.

2.3.1 Water Quality Program Fundamental Objectives

The further description of the vision in the *Water Quality Program Plan* (WQPP) identifies a breakdown into five fundamental objectives for water quality. The five identified objectives include:

1) Improve ecosystem water quality;

2) Improve agricultural use water quality;

3) Improve industrial use water quality;

4) Improve recreational use water quality; and

5) Improve drinking water quality.

As the charts in Appendix A show, these five objectives may be further defined by an expanded set of subobjectives. The expanded set of fundamental objectives describes the types of water quality issues related to water-carried constituents normally found in Delta waters. The WQPP includes ten chapters that describe how these constituents impact water quality in the Delta system. Each chapter includes an objective, a summary of existing water quality concerns with the parameter, a problem statement and a problem description. The "objective" sections in the WQPP formed the basis for a number of the subobjectives shown in the fundamental objectives hierarchy in Appendix A. Table 2-1 shows the summary of water quality parameters of concern to beneficial uses that were identified in the WQPP.

2.3.2 Water Quality Program Means-Ends Objectives

The WQPP also includes a description of the implementation strategy for the Water Quality Program. This strategy is focused primarily on the first seven years following the Record of Decision on the programmatic EIS/EIR. However, the general means-ends objectives identified for the first seven years will continue to be valid throughout

Table 2-1

Water Quality Parameters of Concern to Beneficial Uses

Metals and Toxic Elements	Organics/ Pesticides	Disinfection By-Product Precursors	Other
Cadmium Copper Mercury Selenium Zinc	Carbofuran Chlordane Chlorpyrifos DDT Diazinon PCBs Toxaphene	Bromide TOC	Ammonia Dissolved Oxygen Salinity (TDS,EC) Temperature Turbidity Pathogens Nutrients pH (Alkalinity) Chloride Boron Toxicity of unknown origin Sodium Adsorption Ratio

Phase III of the CALFED Program. Specific means-ends objectives will be revised through adaptive management based on the results of the studies and projects implemented during the first seven years.

The general means-ends objectives for the WQP include:

- Conduct turbidity and sediment control work;
- Conduct salinity reduction work;
- Identify and remediate metals pollution;
- Conduct nutrient effect studies and implement results;
- Conduct drinking water improvement studies and projects;
- Conduct selenium evaluation and abatement work;
- Conduct sediment control projects to reduce organochlorine pesticides;
- Identify pesticide levels and reduce to non-toxic levels;
- Conduct mercury evaluation and abatement work; and
- Identify unknown toxicity sources.

The charts in Appendix A illustrate the subcategories of actions (means-ends objectives) described in the implementation strategy of the WQPP. Some of the means-ends objectives are related to one or more of the fundamental objectives listed on the chart. The WQPP provides detailed descriptions of the means-ends for the first seven years of program implementation.

2.4 Levee System Integrity Program

This section addresses the fundamental and means-ends objectives relating to the Levee System Integrity Program (Levee Program). The Levee Program includes objectives and programmatic actions to improve the integrity of the levees within the Delta and Suisun Marsh. Information regarding the Levee Program has been culled from the *Levee System Integrity Program Plan* (June 1999) (Levee Program Plan), which was a technical appendix to the *Draft Programmatic EIS/EIR.*

2.4.1 Levee Program Fundamental Objectives

The Levee Program is designed to address the CALFED fundamental objective to "Reduce the risk to land use and associated economic activities, water supply, infrastructure and the ecosystem from catastrophic breaching of Delta Levees."[6]

The fundamental objectives of the Levee Program are relatively concise and straightforward. The Levee Program Plan focuses primarily on the means-ends objectives involved in improving the integrity of the levee system to achieve fundamental objectives. Appendix A presents the Levee Program fundamental objectives hierarchy.

2.4.2 Levee Program Means-Ends Objectives

The means-ends objectives in the Levee Program are developed from two sub-objectives of the fundamental objective:

- Maintain and improve the integrity of the Delta Levee System; and
- Integrate ecosystem restoration and Delta conveyance actions with levee improvement activities.

The first objective was further defined by five means-ends objectives, from which the five program elements of the Levee Program were developed.

1) Improve all Delta levees to a uniform base standard (Delta Levee Base Level Protection Plan).

2) Provide additional flood protection separate from the Base Level Protection element for Delta islands that protects such public benefits as water quality, the ecosystem, life and personal property, agricultural production, cultural

[6] *Levee System Integrity Program Plan* (June 1999) p. 1-5.

resources, recreation, and local and state-wide infrastructure (Delta Levee Special Improvement Projects).

The Levee Program focuses primarily on means-ends objectives.

3) Reduce or eliminate the risk to levee integrity from subsidence and assist in the coordination of subsidence-related linkages with other CALFED programs (Delta Levee Subsidence Control Plan).

4) Enhance existing emergency management response capabilities in order to protect critical Delta resources in the event of a disaster (Delta Levee Emergency Management and Response Plan).

5) Quantify the risks to Delta levees, evaluate the consequences, and develop an appropriate risk management strategy (Delta Levee Risk Assessment and Risk Management Strategy).

The other fundamental objective of the Levee Program (to integrate ecosystem restoration and water management with the Levee Program) focuses on linkages between the Levee Program and other CALFED programs. In some cases, ecosystem restoration and levee protection conflict where levee protection measures, such as removal of vegetation, may result in decreased ecosystem quality. Elements of the Water Management Strategy also have the potential to impact the Levee Program. Any changes in conveyance or storage, for example, will affect the hydraulics in the Delta and consequently affect levee protection and maintenance.

The means-ends objectives for the Levee Program are fully developed in the charts in Appendix A.

2.5 Water Management Strategy

The Water Management Strategy (WMS) will coordinate and integrate the activities of several key CALFED program elements in order to help secure sufficient, reliable water supplies to support environmental, urban and agricultural beneficial uses. Section 2.5.1 presents the fundamental objectives of the WMS and Section 2.5.2 provides an overview of the means-ends objectives available for meeting the WMS goals.

The WMS objectives presented can be found in the following documents:

- *Water Use Efficiency Program Plan* (June 1999)
- *Water Transfer Program Plan* (June, 1999)
- *Watershed Program Plan* (June 1999)
- *Comprehensive Monitoring Assessment and Review Program Report* (June 1999)

- *Revised Phase II Report* (June 1999)
- *Economic Evaluation of Water Management Alternatives* (October 1999)

"Although the WMS will serve as a single integration point for developing programmatic objectives much of the work on refining the WMS is being conducted within CALFED's eight program elements."[7]

2.5.1 Water Management Strategy Fundamental Objectives

The primary fundamental objective of the WMS is stated in the program mission statement:

> "Reduce the mismatch between Bay Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system."

This statement represents the fundamental objective of broadest concern in CALFED's approach to water management decision making. Appendix A presents a hierarchy of the fundamental objectives for the WMS.

Means-ends objectives for the Water Management Strategy are the source of many of the major conflicts regarding the CALFED program.

The Revised Phase II Report further defines the fundamental objective into subobjectives including:

- Increase the utility of available water supplies (making water suitable for more uses and reuses);
- Improve access to existing or new water supplies; and
- Improve the flexibility of managing water supply and demand.[8]

2.5.2 Water Management Strategy Means-Ends Objectives

The means-ends objectives for the WMS are better developed, although they are the source of many of the major conflicts regarding the CALFED program. There are seven primary means-ends objectives for the Water Management Strategy:

1) Water Transfers - redirect water from one use to another on a voluntary and compensated basis;

2) Water Use Efficiency - ensure that water supply is used efficiently and results in multiple benefits;

3) Water Storage - implement new storage facilities;

[7] *Revised Phase II Report* (June, 1999) p. 54
[8] *Revised Phase II Report* (June 1999) p. 62.

4) Water Conveyance - improve conveyance options to distribute water;

5) Watershed Management - encourage broad participation in the CALFED program by supporting local and regional activities to improve watershed processes;

6) Water Quality - improve water quality to improve water utility; and

7) Water Supply Operations - improve operational strategies by including real-time feedback from monitoring program.

A hierarchy of means-ends objectives is presented in Appendix A. Four of the seven means-ends objectives are currently supported by individual CALFED program element plans including *Water Transfer Program Plan, Water Use Efficiency Program Plan, Watershed Management Plan* and the *Water Quality Program Plan*. Alternative approaches to storage, conveyance, and water supply operations are evaluated in the *Draft Programmatic EIS/EIR* impact analysis. The *Draft Programmatic EIS/EIR* includes many means-ends objectives.

Studies completed and underway under CALFED's Integrated Storage Investigation (ISI) will provide additional detail regarding the feasibility of various surface and ground water storage options as a means for attaining CALFED's water supply reliability goals and objectives. Specifically, the ISI will evaluate surface storage, groundwater storage, power facility reoperation and the potential for conjunctive operation of these different types of storage.

2.6 Solution Principles

As described in Section 1, the *Revised Phase II Report* defines Solution Principles that must be satisfied by WMS alternatives. The solution principles are presented as separate and distinct from the CALFED mission statement. During the course of the WMSEF work, it was proposed that the Solution Principles are fundamental objectives for which means-ends objectives and performance measures have not been fully developed. The CALFED Solution Principles are defined as follows:

- *Reduce Conflicts in the System:* Solutions will reduce major conflicts among beneficial uses of water.

- *Be Equitable:* Solutions will focus on solving problems in all problem areas. Improvements for some problems will not be made without corresponding improvements for other problems.

- *Be Affordable:* Solutions will be implementable and maintainable within the foreseeable resources of the Program and stakeholders.

- *Be Durable:* Solutions will have political and economic staying power and will sustain the resources they were designed to protect and enhance.

- *Be Implementable:* Solutions will have broad public acceptance and legal feasibility, and will be timely and relatively simple to implement compared with other alternatives.

- *Have No Significant Redirected Impacts:* Solutions will not solve problems in the Bay-Delta system by redirecting significant negative impacts, when viewed in their entirety, within the Bay-Delta or to other regions of California.

These principles are critically important to the majority of the stakeholders and encompass ideas that are central to the CALFED program.

Section 3
Performance Measures

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Section 3
Performance Measures - Indicators of Success

In order for stakeholders to assess how a particular WMS alternative performs with respect to their areas of interest, stakeholders must be provided clear, relevant comparisons of the alternative's performance relative to other alternatives. Performance measures are the indicators of the success of an alternative in meeting a particular fundamental objective. A comprehensive set of descriptive performance measures can be considered the "scorecard" or "report card" for an alternative and is essential for assessing, for each stakeholder, the benefits derived from an alternative and the potential for tradeoffs among alternatives. This section describes criteria for establishing performance measures and presents a summary of proposed performance measures for each CALFED program.

3.1 Performance Measure Criteria

Performance measures for water management alternatives must provide relevant information and must be measurable. If they are to be used in decision making for long-range planning, performance measures must also be predictive. Typically, mathematical models are used to simulate a system and predict its behavior relative to a particular performance measure. In the case of the evaluations used to refine CALFED's WMS, execution of a series of models is required to predict the hydrologic and economic performance of alternatives.

Performance measurements must be estimable in advance of the action to be useful during the decision-making process.

Measures and indicators are discussed in several CALFED documents,[1] but many are monitoring measures, rather than predictive performance measures. Monitoring measures are typically used after a project is implemented to evaluate its success, but generally cannot be used prior to implementation to predict success. Performance measurements must be estimable in advance of the action to be useful during the decision-making process.

It is generally preferable to have quantitative performance measures (e.g. the amount of water transferred from a region in thousands of acre-feet per year). In many cases, however, a qualitative performance criterion (e.g. the relative ease of obtaining necessary permits for alternative storage projects: low; medium; or high) may be all that is available. This may be sufficient for stakeholders to distinguish the relative performance of alternatives.

Stakeholders requested an indication of the technical "level of confidence" associated with predictive performance measures. A level of confidence recognizes that

[1] *Comprehensive Monitoring Assessment and Review Program Report* (June 1999), *Revised Phase II Report* (June 1999) and the various program plans.

uncertainties related to future events cannot be predicted perfectly and that some measures may be predicted with more confidence than others. Stakeholders also requested that assumptions used in predicting the alternatives' measurements be documented clearly.

3.2 Performance Measurement Location

Performance measures associated with alternatives for a large system such as the Bay-Delta and its tributaries must be viewed at a meaningful geographic level. Consideration must also be given to the appropriate level of resolution for the available analytical tools. For the programmatic level of analyses that are being conducted for the WMS, a balance must be struck between providing information in a concise form that can be readily understood and providing sufficient detail to thoroughly describe potential outcomes of alternative approaches. Viewing regional measurements will allow stakeholders to examine performance of alternatives at an appropriate scale and across regions and sectors. The CALFED staff will aggregate and synthesize performance measures from more detailed analyses and data to produce relevant performance measure information.

For evaluations currently underway to aid in refining the WMS, the following regions are currently being considered:

Viewing regional measurements will allow stakeholders to examine performance of alternatives at an appropriate scale.

- Sacramento River Valley Region;
- Bay-Delta Region;
- San Francisco Bay Region;
- San Joaquin River Valley Region;
- Tulare Basin Region;
- Central and South Coast Region;
- Up-stream water users; and
- System-wide (all of the above combined).

3.3 Predictive Performance Measures

To be useful for refining the WMS, it is necessary that selected performance measures be limited to those that can be analyzed using currently available predictive models. Table B-1, Predictive Performance Measures (Appendix B), presents the recommended performance measures, indicates their relationship with fundamental objectives and shows the level of confidence associated with the measures. Levels of confidence shown in Table B-1 are based on professional judgement, and consider the certainty of the results from available analytical tools and input data.

3.4 Detailed Performance Measures

Along with the predictive performance measures described above, Table B-2, Detailed Performance Measures (Appendix B), presents a set of detailed performance measures. Table B-2 includes the measures and indicators described in the various program plans. Some of the detailed performance measures duplicate the predictive measures shown in Table B-1, and are also recommended to be included as monitoring measures for future decision making and adaptive management.

Section 4
References

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Section 4
References

CALFED Bay-Delta Program. 1999. Comprehensive Monitoring Assessment and Review Program Report. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Draft Programmatic EIS/EIR. June. Sacramento, CA.

_____. 1999. Economic Evaluation of Water Management Alternatives. October. Sacramento, CA.

_____. 1999. Ecosystem Restoration Program Plan. Volume 1. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Ecosystem Restoration Program Plan. Volume 2. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Ecosystem Restoration Program Plan. Maps. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Levee System Integrity Program Plan. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Revised Phase II Report. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Water Use Efficiency Program Plan. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Water Transfer Program Plan. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Watershed Program Plan. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

_____. 1999. Water Quality Program Plan. (Technical appendix to programmatic EIS/EIR). June. Sacramento, CA.

Keeney, Ralph L. 1992. Value Focused Thinking. Harvard University Press, Cambridge, MA.

Appendix A
Objective Charts

CALFED
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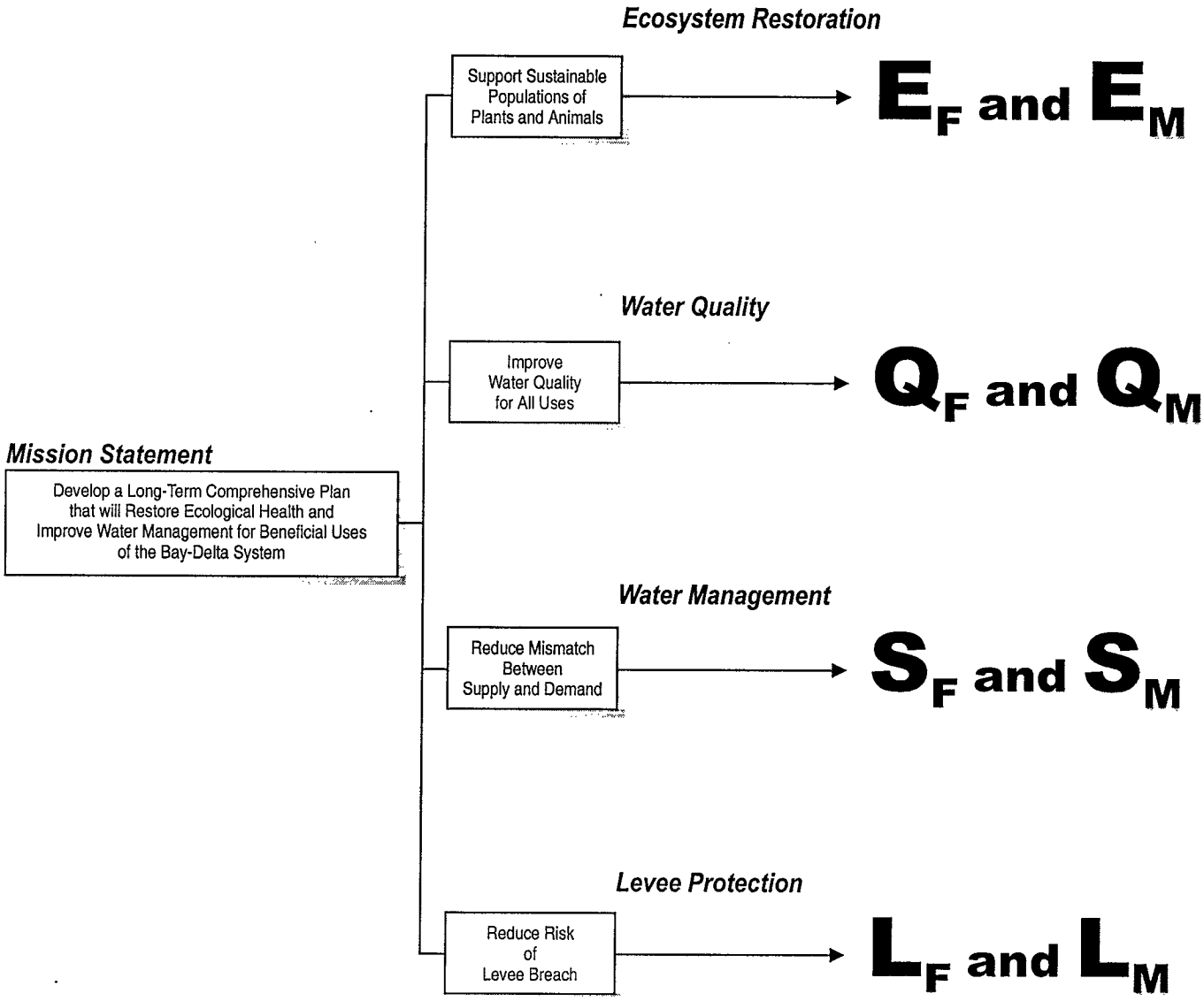


E_F Q_F S_F L_F = *Fundamental Objectives*

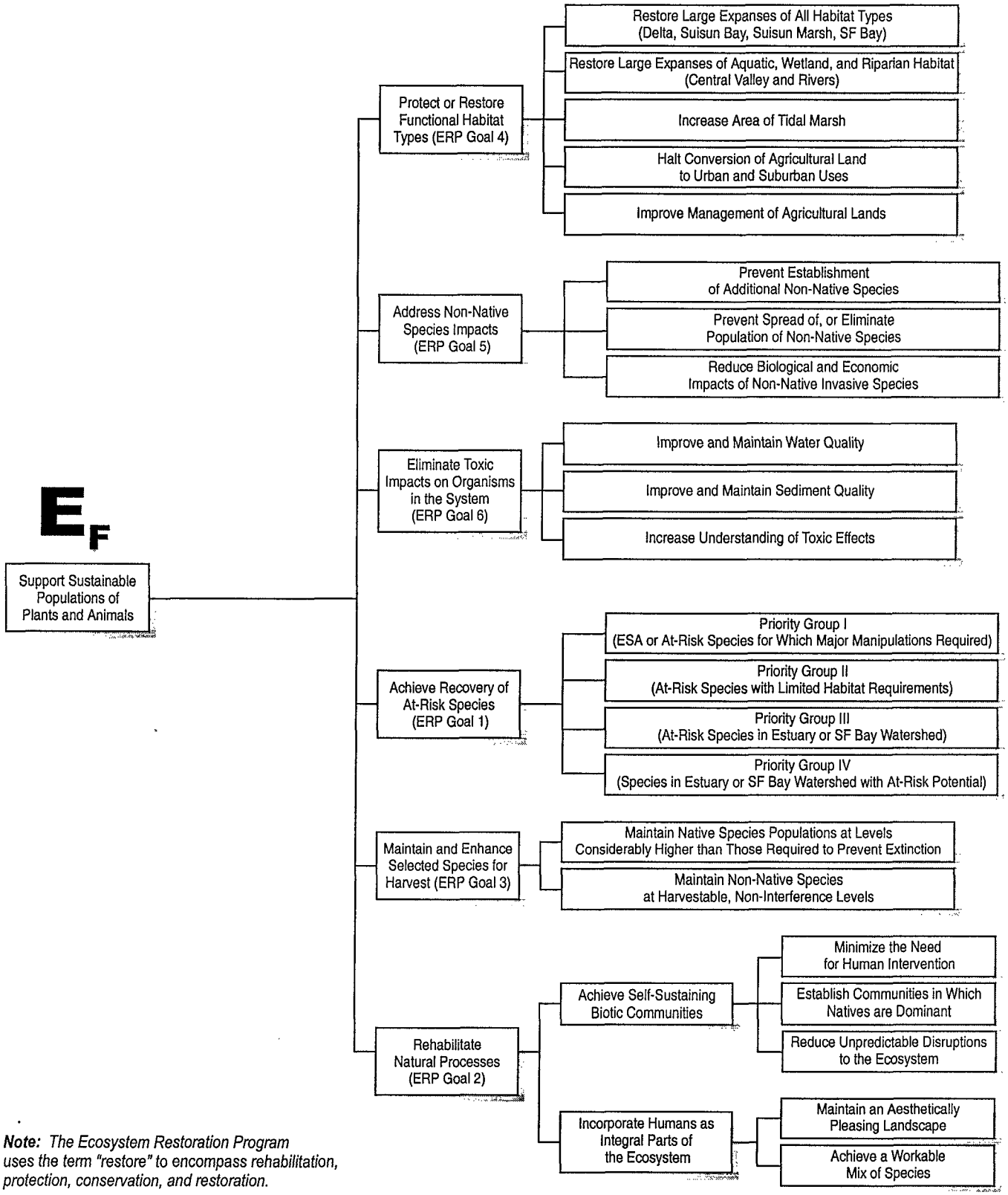
E_M Q_M S_M L_M = *Means-Ends Objectives*

CALFED BAY-DELTA PROGRAM

Fundamental Objectives

E—007756

E-007756



Note: *The Ecosystem Restoration Program uses the term "restore" to encompass rehabilitation, protection, conservation, and restoration.*

CALFED BAY-DELTA PROGRAM

Fundamental Objectives
Ecosystem Restoration

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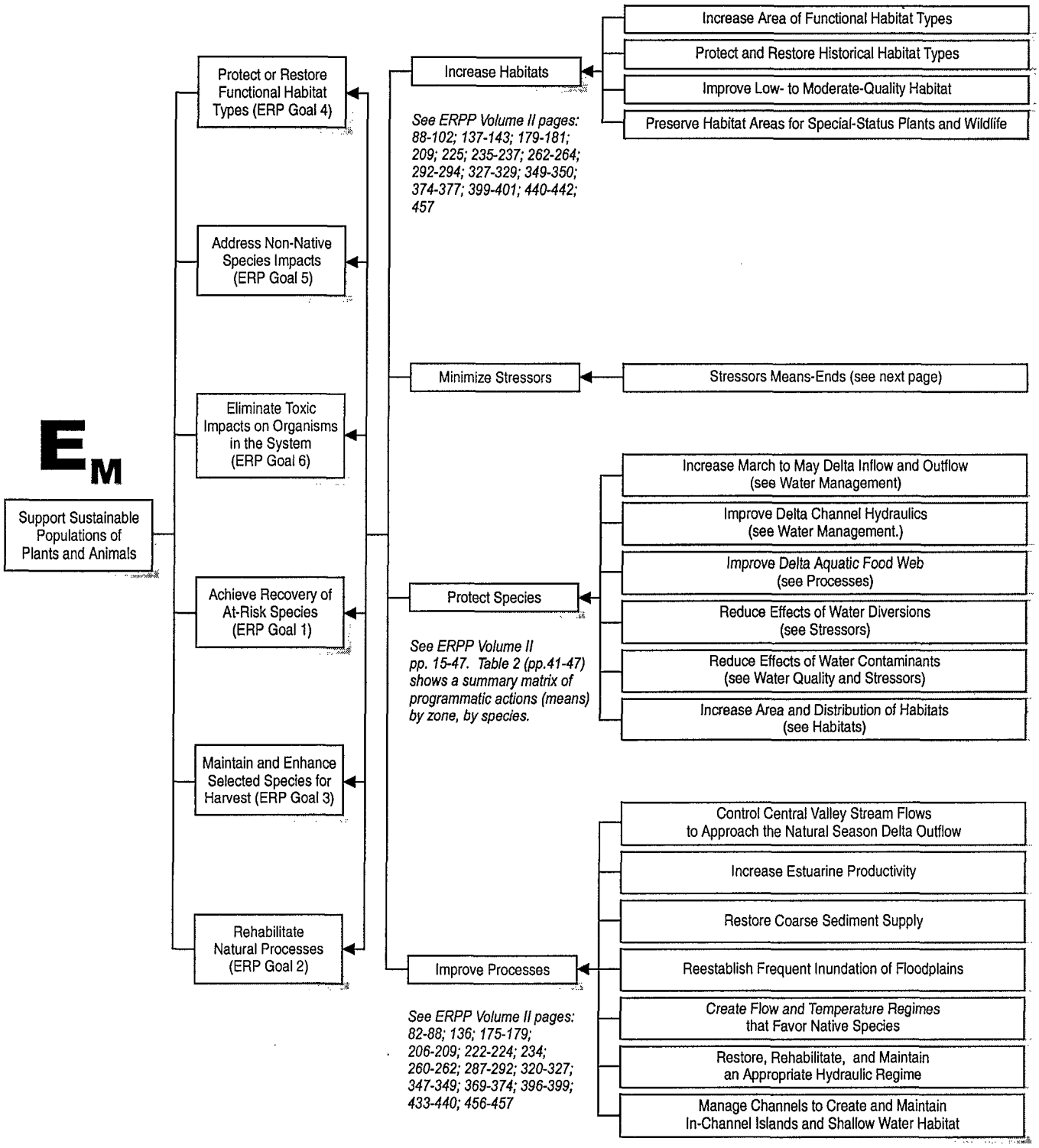
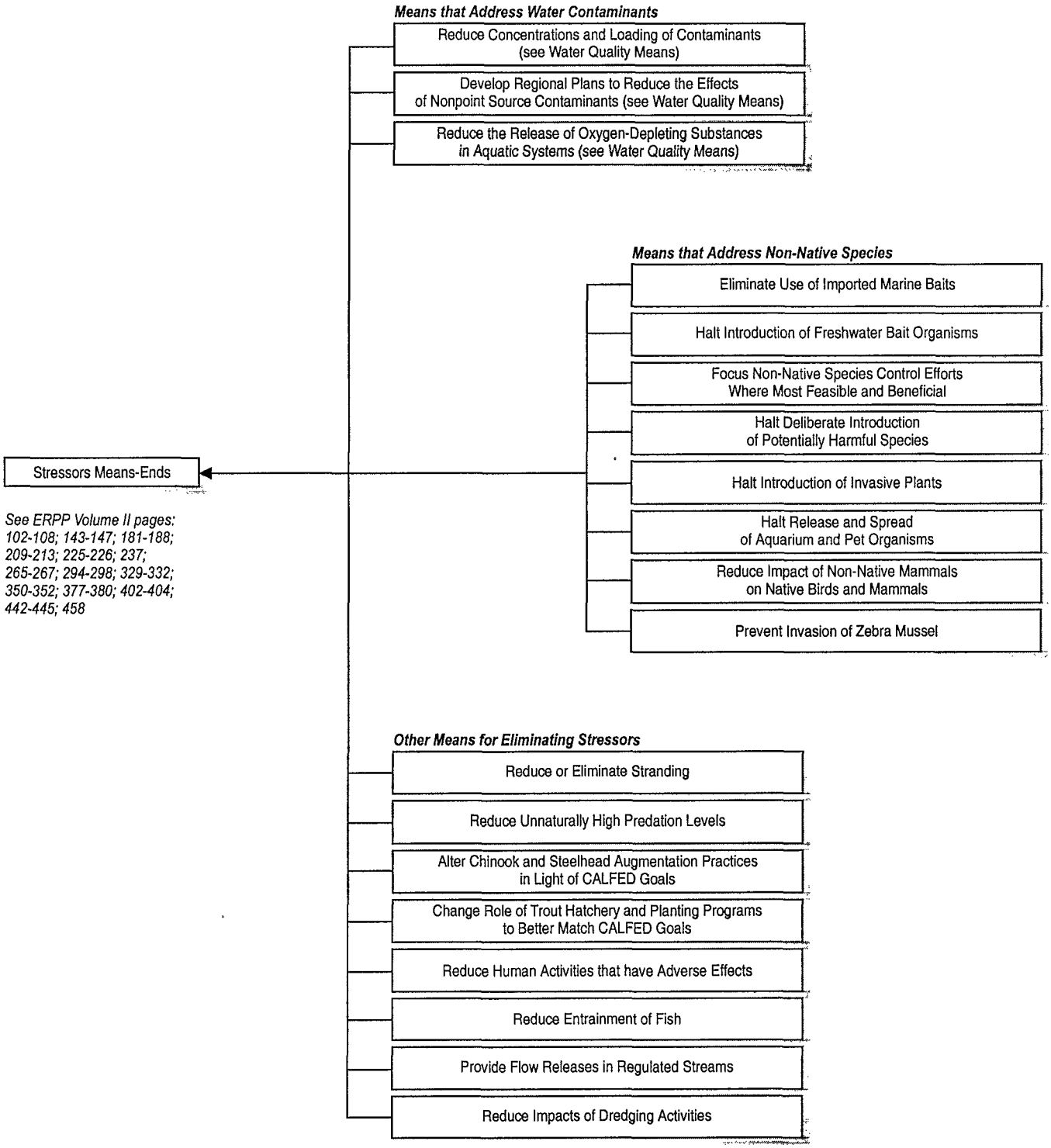


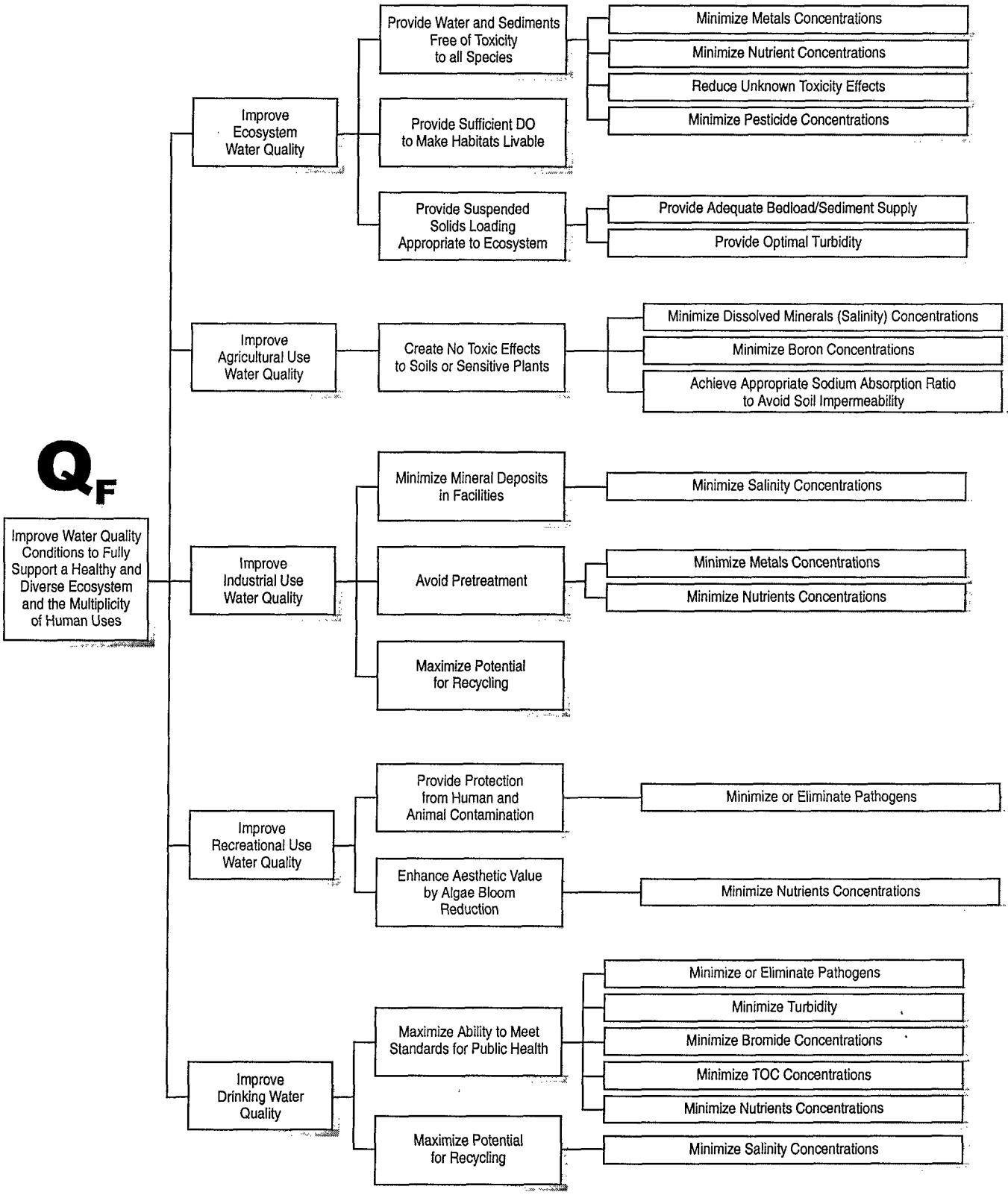
CALFED BAY-DELTA PROGRAM

Means-Ends Objectives Ecosystem Restoration



CALFED BAY-DELTA PROGRAM

Means-Ends Objectives
Ecosystem Restoration (cont.)



CALFED BAY-DELTA PROGRAM

Fundamental Objectives
Water Quality

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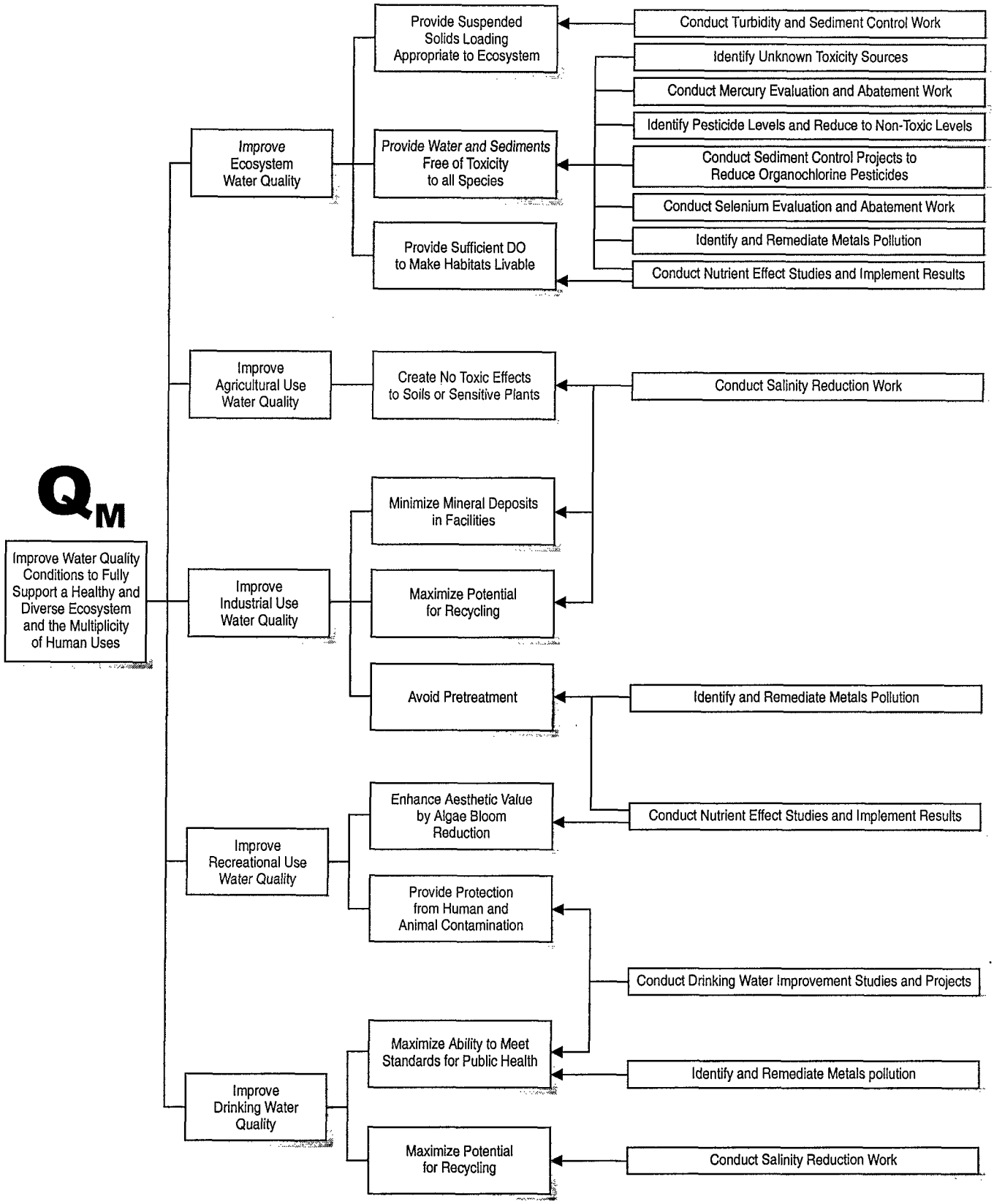

CALFED BAY-DELTA PROGRAM

Means-Ends Objectives
Water Quality

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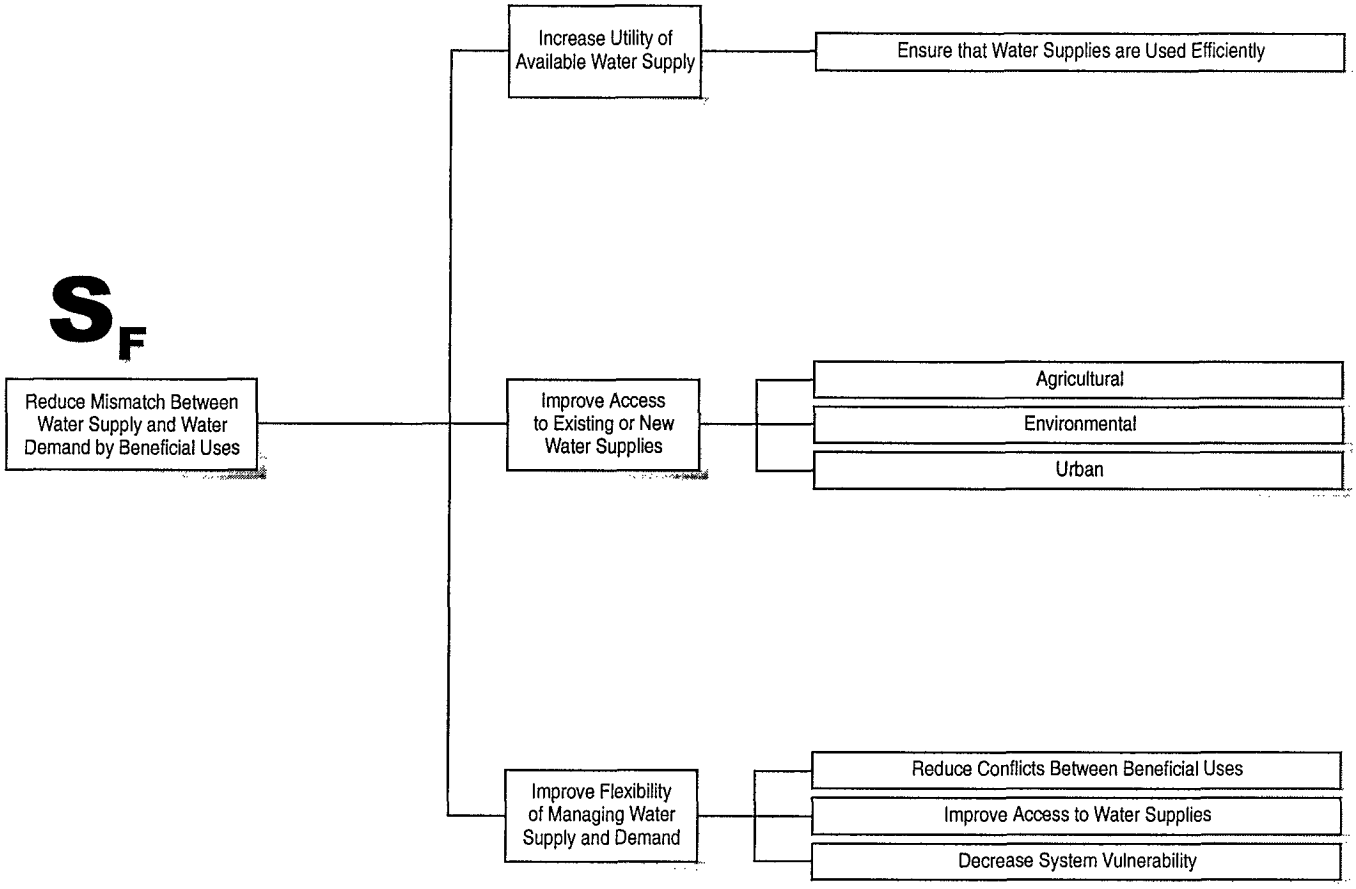

CALFED BAY-DELTA PROGRAM

Fundamental Objectives
Water Management

E—007762

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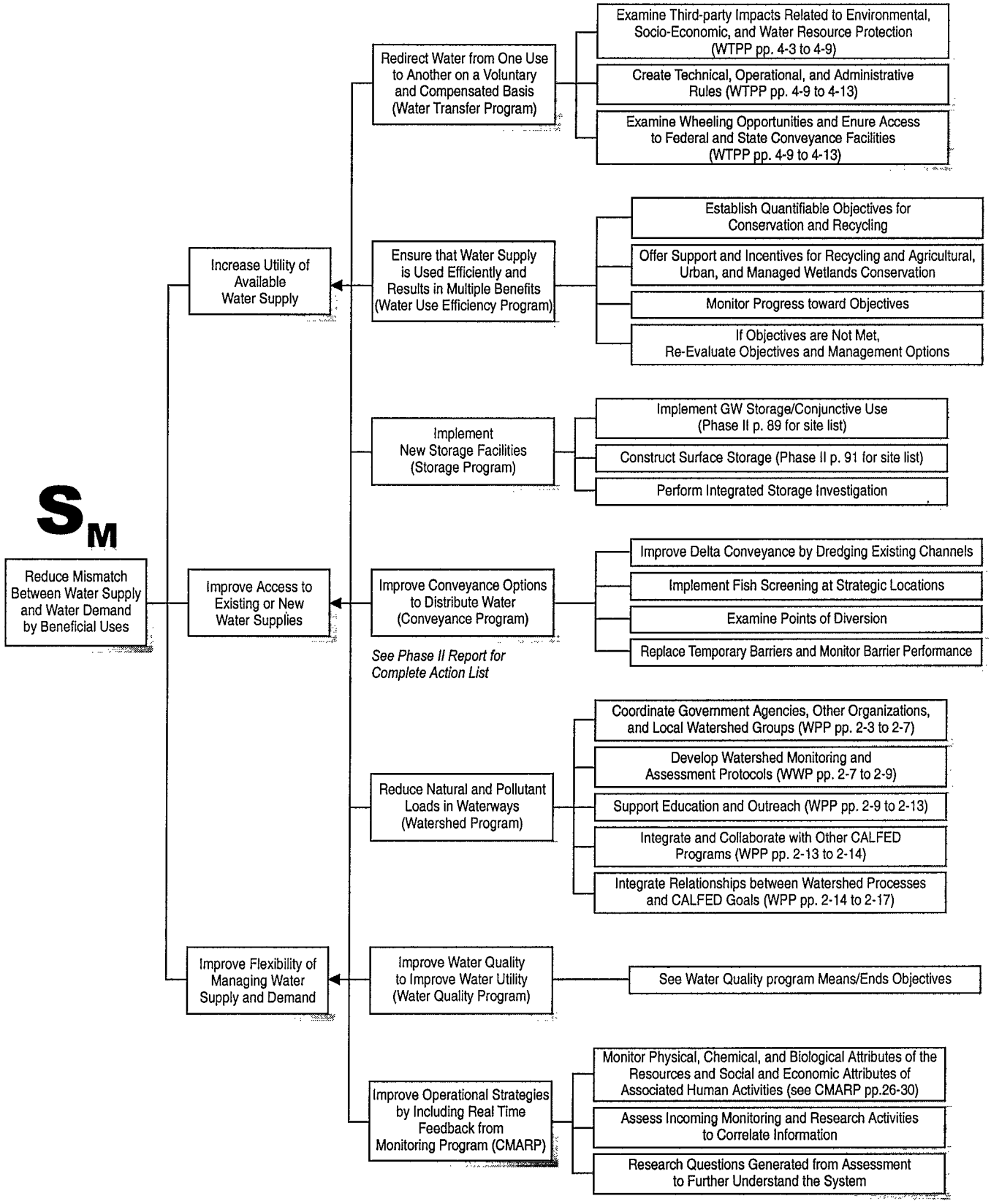

CALFED BAY-DELTA PROGRAM

Means-Ends Objectives
Water Management

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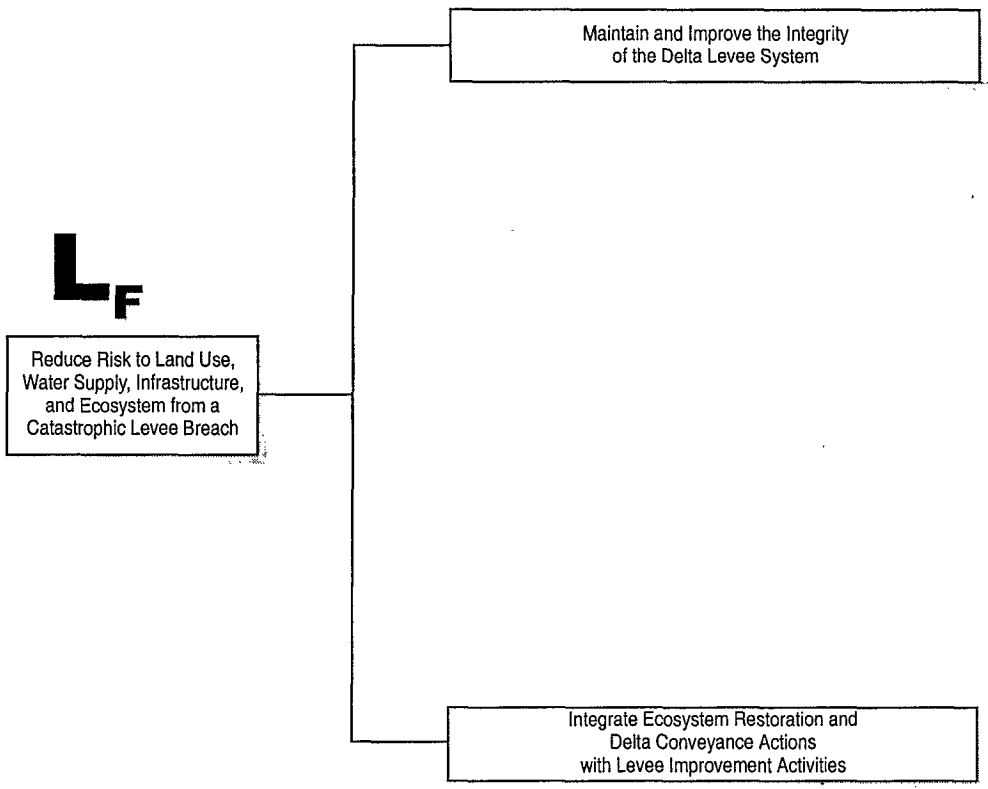

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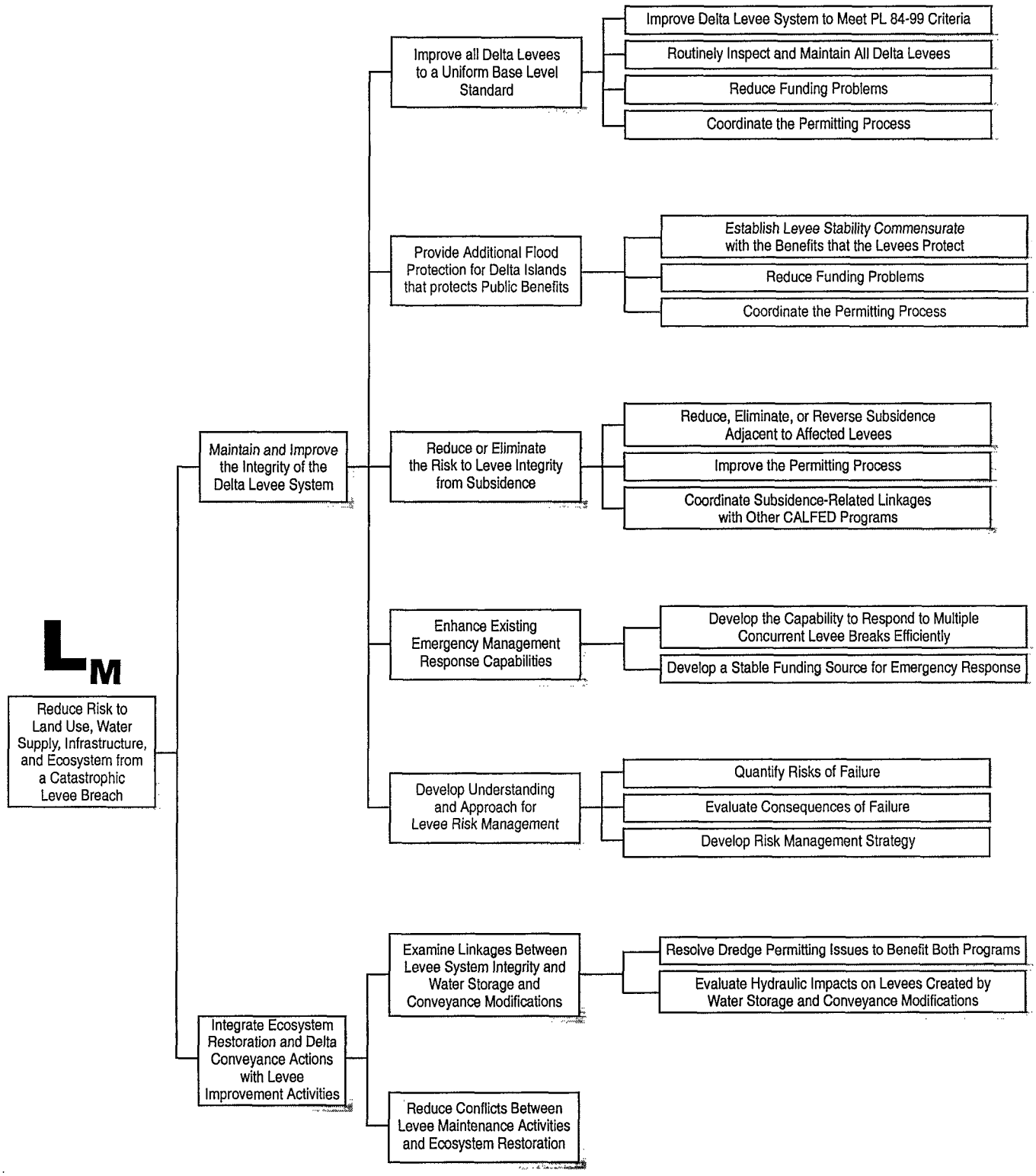
Fundamental Objectives
Levee Protection



CALFED BAY-DELTA PROGRAM

Means-Ends Objectives
Levee Protection

E-007765

E-007765

Appendix B
Performance Measures

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Table B-1 Predictive Performance Measures

Fundamental Objectives	Performance Measures (units)	Level of Confidence[1]
Ecosystem Restoration		
Protect or restore functional habitat (ERP Goal 4)	Level of investment as defined by the ERP ($/year) Changes in habitat due to water facility construction (acres) *See detailed ERP list Table C-2*	High High
Address non-native species impacts (ERP Goal 5)	Level of investment as defined by the ERP ($/year) *See detailed ERP list Table C-2*	High
Eliminate toxic impacts on organisms in the system (ERP Goal 6)	Level of investment as defined by the ERP ($/year) *See detailed ERP list Table C-2*	High
Achieve recovery of at-risk species (ERP Goal 1)	Level of investment as defined by the ERP ($/year) Stream temperature (Deg F) Stream flow above minimum requirements (cu-ft/sec) Period pumping curtailed to reduce entrainment (days) Changes in habitat due to water facility construction (acres) *See detailed ERP list Table C-2*	High Low High Medium High
Maintain and enhance selected species for harvest (ERP Goal 3)	Level of investment as defined by the ERP ($/year) *See detailed ERP list Table C-2*	High
Rehabilitate natural processes (ERP Goal 2)	Level of investment as defined by the ERP ($/year) X2 location (River mile) Stream temperature (Deg F) Stream flow rates (cu-ft/sec) *See detailed ERP list Table C-2*	High High Low High
Water Quality		
Improve ecosystem quality	Level of investment ($/year) Stream temperature (Deg F) Total Exports (acre-ft/year) X2 Location (river mile)	High Low High High
Improve agricultural use water quality	Salinity (mg/L)	Varies
Improve industrial use water quality	Salinity(mg/L) Total water management costs ($/year)	High High
Improve recreational use water quality		
Improve drinking water quality	Salinity (mg/L) Bromide (mg/L) Total Organic Carbon (mg/L) Total water management costs ($/year)	Varies Medium Low High

Table B-1 Predictive Performance Measures (cont.)

Fundamental Objectives	Performance Measures (units)	Level of Confidence[1]
Levee Protection		
Improve Delta levees to uniform standard	Level of investment ($/year) *See detailed Levee Protection list Table C-2*	High
Provide additional flood protection for Delta Islands	Level of investment ($/year) *See detailed Levee Protection list Table C-2*	High
Reduce or eliminate risk to levee integrity from subsidence		
Enhance existing emergency response capabilities		
Develop understanding and approach for levee risk management		
Examine linkages between levee integrity and storage and conveyance		
Reduce conflicts between levee maintenance and ERP		
Water Supply Performance Measures - Detailed List of Available Predictive General Measures		
Objective: Reduce mismatch between water supply and demand by beneficial uses		
Costs	Total costs system-wide ($) Annualized costs system-wide ($/year) Allocation of costs system-wide ($/Sector) Urban shortage costs ($/year) Local urban option costs ($/year) Water Treatment Costs ($/year) Change in agricultural production ($/year) Change in groundwater costs ($/year) Employment effects ($) Cost of agricultural conservation measures ($/acre) Land Values ($/acre)	High High Medium Medium Medium Medium Medium Medium Medium Medium Low
Water supply delivery measures	Frequency of shortage (#/ year) Magnitude of shortage (TAF, % of total) Time to recover from shortage (years) Long-term average -- 50% exceedance (TAF) Dry and critical average -- 80% exceedance (TAF) Percent of demand targets (%)	High High High High High High
Water transfer market measures	Amounts transferred from each region (TAF) Amounts received by each region (TAF) Total regional supply made up with transfers (%) Allocation of transfers from region to destination (TAF) Economic marginal value of water transferred ($/TAF)	Medium Medium Medium Medium Medium
Conservation measures	Local urban options implemented (TAF/ technology type) Level of agricultural conservation implemented (TAF)	Medium Low
Adaptability measures	Increments of capital investment required ($/year) Ease of modifying water management strategy based on new observed information (qualitative) Ability to measure performance (qualitative)	High Low Low
Groundwater measures	Change in regional groundwater levels (feet) Overdraft status (TAF/year) Salt loading (pounds/acre/year)	Medium Medium Low

Table B-1 Predictive Performance Measures (cont.)

Fundamental Objectives	Performance Measures (units)	Level of Confidence[1]
Solution Principles	**Performance Measures**	
Reduce conflicts in the system. Solutions will reduce major conflicts among beneficial uses of water.		
Be equitable. Solutions will focus on solving prolems in all problem areas. Improvements for some problems will not be made without corresponding improvements for other problems.	Allocation of costs for actions taken ($/year) Allocation of benefits ($/years)	Medium Medium
Be affordable. Solutions will be implementable and maintainable within the foreseeable resources of the Program and stakeholders.	Total and annualized costs ($, $/year) Allocation of costs and benefits by sector and region ($) Increments of capital investment required ($) Transfer market price ($/acre-ft) Cost of water treatment ($/acre-ft)	High Medium High Low Medium
Be durable. Solutions will have political and economic staying power and will sustain the resources they were designed to protect and enhance.	Long-term average (TAF, %) Ease of modifying strategy based on new information (qualitative)	High Low
Be implementable. Solutions will have broad public aceptance and legal feasibility, and will be timely and relatively simple to implement compared with other alternatives.		
Have no significant redirected impacts. Solutions will not solve problems in the Bay-Delta system by redirecting significant negative impacts, when viewed in their entirety, within the Bay-Delta or to other regions of California.	Regional employment effects ($/year) Change in acres in regional agricultural production (acres) Change in regional crop mix (acres/crop type) Change in regional urban costs ($/year)	Medium Medium Medium Medium

Notes:

[1] Level of confidence is an indicator of the relative accuracy of analytical procedures

TAF = thousand acre-feet

Table B-2 Detailed Performance Measures

Fundamental Objectives		Performance Measures (units)
Ecosystem Restoration		
Protect or restore functional habitat (ERP Goal 4)	Restore large expanses of all habitat types (Delta, Suisun Bay, Suisun Marsh, SF Bay)	Area restored (acres), length restored (linear miles)
	Restore large expanses of aquatic, wetland & riparian habitat (Central Valley & Rivers)	Area restored (acres)
	Increase area of tidal marsh	Area restored (acres)
	Halt conversion of agricultural land to urban & suburban uses	Area converted from agricultural uses to urban and suburban uses (acres)
	Improve management of agricultural lands	Area of agricultural land under cooperative management programs (acres)
Address non-native species impacts (ERP Goal 5)	Prevent establishment of additional non-native species	Number of new non-native species (#)
	Prevent spread of, or eliminate population of non-native species	Number of non-native species (#)
	Reduce biological and economic impacts of non-native invasive species	
Eliminate toxic impacts on organisms in the system (ERP Goal 6)	Improve and maintain water quality	(See water quality measures)
	Improve and maintain sediment quality	(See water quality measures)
	Increase understanding of toxic effects	Number of studies (#)
Achieve recovery of at-risk species (ERP Goal 1)	Priority Group I (ESA or at-risk species for which major manipulations required)	Distribution (catches in various zones) and abundance (numbers or total catch); median number; mean population (#); survival rate (ratio)
	Priority Group II (at-risk species w/ limited habitat requirements)	Population, number of breeding pairs, number of populations (#) high-priority plant species habitat protected (acres)
	Priority Group III (at-risk species in estuary or SF Bay watershed)	Population, number of breeding pairs, number of populations, number of habitat sites or acres provided (#)
	Priority Group IV (Species in estuary or SF Bay watershed w/at-risk potential))	Abundance index, distribution (#), area of habitat restored (acres)
Maintain and enhance selected species for harvest (ERP Goal 3)	Maintain native species populations at levels considerably higher than those required to prevent extinction	Abundance index, distribution (#)
	Maintain non-native species at harvestable, non-interference levels	Abundance index, distribution (#)

Table B-2 Detailed Performance Measures (cont.)

Fundamental Objectives		Performance Measures (units)
Ecosystem Restoration (cont.)		
Rehabilitate natural processes (ERP Goal 2)	Minimize the need for human intervention	Number of actions required (#)
	Establish communities in which natives are dominant	Ratio of native abundance index: non-native abundance index
	Reduce unpredictable disruptions to the ecosystem	
	Maintaining an aesthetically pleasing landscape	
	Achieve a workable mix of species	
Water Quality		
Improve Ecosystem Quality	Provide water and sediments free of toxicity to all species	Metals concentrations in water (mg/L), sediments (mg/kg) and fish tissue (µg/g) at specified locations
		Nitrate and ammonia concentrations (mg/L) at specified locations
		Chronic toxicity and acute toxicity levels west of Antioch Bridge
		Pesticide concentrations in water (mg/L), sediments (mg/kg) and fish tissue (µg/g) at specified locations
		Maximum daily temperature (degrees)
	Provide sufficient DO to make habitats livable	Dissolved oxygen concentrations (mg/L) at specified locations
		Biochemical oxygen demand concentrations (mg/L) at specified locations
	Provide suspended solids loading appropriate to ecosystem	Bedload sediment concentrations (mg/L)
		Water column turbidity (NTU) in Delta
Improve Agricultural Use Water Quality	Create no toxic effects to soils or sensitive plants	Monthly average TDS concentrations (mg/L) at Ag intakes in Delta, Maximum conductivity (µmhos/cm) for Sacramento and San Joaquin Rivers
		Boron concentrations at Ag intakes in Delta Monthly mean boron concentrations (mg/L) San Joaquin River
		Sodium adsorption ratio at specified locations
Improve Industrial Use Water Quality	Minimize mineral deposits in facilities	Salinity concentrations at specified locations (ppt)
	Avoid need for pretreatment	Metals concentrations (mg/L) at specified locations
		Nutrient concentrations (mg/L)at specified locations
	Maximize potential for recycling	Salinity concentrations at specified locations (ppt)
Improve Recreational Use Water Quality	Prevent human and animal contamination	Pathogen counts (#/100 mL)
	Enhance aesthetic value by algae bloom reduction	Nutrient concentrations (mg/L) at specified locations
Improve Drinking Water Quality	Maximize ability to meet standards for public health	Pathogen counts (#/100 mL)
		Turbidity levels at specified locations (NTU)
		Bromide concentrations (mg/L) at specified locations
		TOC concentrations (mg/L) at specified locations
		Nitrate and ammonia concentrations (mg/L) at specified locations
	Maximize potential for recycling	10 year average and monthly average maximum TDS concentrations in Delta

Table B-2 Detailed Performance Measures (cont.)

Fundamental Objectives		Performance Measures (units)
Water Supply		
Reduce mismatch between water supply and water demand by beneficial uses	Increase utility of available water supply	Change in groundwater levels (feet)
		Costs due to change in groundwater pumping ($)
		Groundwater overdraft status (Ac-ft/yr)
		Groundwater salt loading (lbs/ac)
		Urban conservation: local option implementation
		Agricultural conservation: level of conservation implemented
		Amounts transferred by region (Ac-ft/yr), ($)
		Amounts received by region (Ac-ft/yr), ($)
		Percentage of total regional supply made up with transfers (%)
		Allocation of transfers from region to destination
	Improve access to existing or new water supplies	Long-term average deliveries (50% exceedance)
		Dry and critical average deliveries (80% exceedance)
		Water supply deliveries as percent of demand targets (%)
	Improve flexibility of managing water supply and demand	Amount delivered by location (Ac-ft)
		Number and frequency of shortages over planning period (#/yr)
		Magnitude of shortages (Ac-ft or % of demand)
		Time to recover from shortages (months)

Table B-2 Detailed Performance Measures (cont.)

Fundamental Objectives		Performance Measures (units)
Levee Protection		
Improve Delta Levees to uniform standard	Initial levee improvements	Total length of levees meeting USACE PL 84-99 standards (miles)
	Inspect and maintain levees	Length of levees maintained to meet USACE PL 84-99 Maintenance Standards (miles)
	Reduce funding problems	Amount of funding received ($/year) and time required to receive funding (months)
	Coordinate permitting process	Time required for regulatory agencies to coordinate and issue all permits (months)
Provide additional *flood protection for* Delta Islands that protects public benefits	Additionally improve levees based on *protected value*	Property damage estimates ($)
	Reduce funding problems	Amount of funding received ($/year) and time required to receive funding (months)
	Coordinate permitting process	Time required for regulatory agencies to coordinate and issue all permits (months)
Reduce or *eliminate* risk to levee integrity from subsidence	Reduce subsidence adjacent to levees	Rate of subsidence adjacent to levees (inches/year) and Zone of Influence (ZOI) (feet), groundwater levels (feet)
	Improve the permitting process	Time required for regulatory agencies to coordinate and issue all permits (months)
	Coordinate linkages with other CALFED programs	Rate of inner island subsidence (inches/year)
Enhance existing emergency response capabilities	Develop capability to respond to multiple breaks	Equipment and operators (type and number of units), material stockpiles (number of locations and cubic feet), available labor (# of personnel)
	Develop funding for emergency response	Funding available for emergency response ($/year)
Develop understanding and approach for levee risk management	Quantify risks of seismic levee failures	Levee failures due to liquefaction (# per 100 miles)
	Quantify risks of levee failures due to overtopping, seepage, subsidence	Levee failures (# per 100 miles)
	Evaluate consequences of levee failures	Property damage estimates ($)
Examine linkages between levee integrity and storage and conveyance	Resolve dredge permitting issues	Dredge permits issued (#) and processing time (months)
	Evaluate hydraulic impacts on levees from storage and conveyance modifications	Water level for levee improvements (ft)
Reduce conflicts between levee maintenance and ERP	N/A	